

ICS 29.180
CCS K 41

DL

**INDUSTRY STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

DL/T 1999-2019

**Field test method for DC partial discharge measurement of
converter transformer
(English Translation)**

Issued on: June 4, 2019

Implemented on: October 1, 2019

Issued by: National Energy Administration

Table of Contents

Preface	2
1 Scope	3
2 Normative references	3
3 Terms and definitions	3
4 Test conditions	4
5 Test equipment and test instruments	4
6 Test wiring	5
7 Test voltage and test procedure	7
8 DC partial discharge measurement	8
9 Judgment of test results	8
10 Identification and suppression of common interference sources	8
Appendix A (informative appendix) The structure and dimensions of the equalizing ring of the valve side casing	10
Appendix B (informative appendix) Differential signal method to suppress spatial interference	12
Appendix C (informative appendix) Interference identification method for DC partial discharge measurement of converter transformer	13

Foreword

This standard is compiled for the first time.

This standard is compiled in accordance with the rules given in GB/T 1.1-2009 "Guidelines for Standardization Work Part 1: Standard Structure and Compilation".

This standard was proposed by the China Electricity Council.

This standard is under the jurisdiction of the National High Voltage Test Standardization Sub-Technical Committee (DL/T C 02).

Drafting organizations of this standard. State Grid Hubei Electric Power Research Institute, China Electric Power Research Institute Co., Ltd., State Grid Shaanxi Electric Power Research Institute, State Grid Electric Power Research Institute Wuhan Nanrui Co., Ltd., State Grid Liaoning Electric Power Co., Ltd.

Electric Power Research Institute, State Grid Gansu Electric Power Company Electric Power Research Institute, Power Industry Electrical Equipment Quality Inspection and Testing Center, Tsinghua University, TBEA Hengyang Transformer Co., Ltd., Baoding

Tianwei Baobian Electric Co., Ltd., Changzhou Toshiba Transformer Co., Ltd., ABB Chongqing Transformer Co., Ltd., Guangzhou Siemens Transformer Co., Ltd., TBEA Co., Ltd., Xi'an Xidian Transformer Co., Ltd.

Company, TBEA Shenyang Transformer Group Co., Ltd., Datang Huainan Luohe Power Plant.

1 Scope

This standard specifies the test conditions, test methods, judgment of test results, and routine tests for DC partial discharge measurement of converter transformers.

See identification and suppression of interference sources.

This standard applies to on-site DC partial discharge measurement of single-phase converter transformers used in DC transmission projects with voltage levels of $\pm 800\text{kV}$ and below.

The $\pm 1100\text{kV}$ converter transformer can be implemented by reference.

2 Normative references

The following documents are indispensable for the application of this standard. For dated reference documents, only the dated version applies to this standard quasi. For undated reference documents, the latest version (including all amendments) is applicable to this standard.

GB/T 2900.33-2004 Electrical Engineering Terminology Power Electronics Terminology
GB/T 2900.95-2015 Electrotechnical terminology transformers, voltage regulators and reactors
GB/T 7354 Partial discharge measurement
GB/T 18494.2-2007 Converter Transformer Part 2: Converter Transformer for HVDC Transmission
DL/T 274 $\pm 800\text{kV}$ HVDC equipment handover test
DL/T 377 HVDC equipment acceptance test
DL/T 417 Partial discharge field measurement guidelines for power equipment
DL/T 1243 On-site partial discharge test technology for converter transformers

3 Terms and definitions

The following terms and definitions as well as those defined in GB/T 2900.33-2004 and GB/T 2900.95-2015 and the following terms and definitions apply to this standard.

DC partial discharge Electrical discharge in which the insulation between conductors is only partially bridged under a DC electric field.

DC partial discharge measurements for converter transformer Apply the specified DC voltage to the valve side winding of the converter transformer and measure whether the partial discharge meets the specified requirements under the DC voltage test.

Note: This definition is consistent with the DC withstand voltage test of the winding and bushing in DL/T 377, the DC withstand voltage test of the valve-side winding and bushing in DL/T 274, and DL/T 1243 the partial discharge test under DC voltage is consistent.

Valid pulses of partial discharge the partial discharge from the converter transformer in the DC partial discharge measurement of the converter transformer, and the apparent partial discharge is greater than the standard given threshold Value of partial discharge pulse.

Partial discharge detect device for DC voltage A digital partial discharge test instrument for continuous detection, recording and statistics of partial discharge under DC voltage.

Differential signal method the difference between the analog signals received by two different paths is connected to the partial discharge meter for detection.

4.1 Test environment

The test environment conditions should meet.

- a) Ambient temperature. 0°C~40°C;
- b) Relative humidity. less than or equal to 80%;
- c) There is no significant dust, smoke, corrosive gas, steam, smoke pollutants or sand in the surrounding air;
- d) There is no significant interference pulse source around.

4.2 The tested converter transformer the tested converter transformer shall meet the following requirements before the test.

- a) The appearance of the equipment is good, and there is no obvious pollution or damage to the outer insulating surface;
- b) The equipment has completed other routine test items, and all the results are qualified;
- c) The converter transformer that has undergone hot oil circulation treatment should be allowed to stand still before the test, and should be fully exhausted in time during the standing period, and the exhaust should be no less than 2 times, keep the vacuum if necessary; when the ambient temperature is lower than 5°C, heat preservation measures should be taken to avoid the oil temperature dropping too fast during the standing period;
- d) Standing time requirements. 500kV and below grade equipment should be no less than 72h, 800kV (including 600kV) grade equipment should be no less than 96h, when the manufacturer provides otherwise, it shall be implemented according to the manufacturer's requirements;
- e) All bushing terminals, fuel tanks, iron cores and clamps shall be reliably grounded, and shall be grounded continuously for at least 2h before the start of the test;

f) The body oil surface temperature should be in the range of 10°C~30°C during the test.

5.1.1 Rated parameters

The rated parameters of the DC high voltage generator should meet.

- a) The rated output current should not be less than 10mA;
- b) The rated output voltage should not be less than 120% of the DC partial discharge measurement test voltage of the converter transformer under test;
- c) Under the rated output voltage, the partial discharge of the DC high-voltage generator body should not exceed 800pC;
- d) Under the conditions of rated output voltage and rated output current, the allowable continuous working time should not be less than 150min.

5.1.2 Polarity, ripple factor and short-term stability of the output voltage waveform

The waveform of the HVDC generator should meet.

- a) The output voltage polarity should be positive (or switchable polarity);
- b) The ripple factor should be less than 3%;
- c) The short-term stability within 5 minutes should not exceed 1%.

5.1.3 Main components

The main components of the DC high voltage generator should meet.

- a) The charging power supply should be a push-pull variable frequency power supply (or other variable frequency power sources that do not generate high frequency pulses), and the frequency conversion range should be selected 30Hz~300Hz, and continuously adjustable.
- b) The body of the voltage doubler rectifier device and the high-voltage DC divider should be connected as a whole, and the body support tube should adopt an umbrella skirt structure; the total height of the device (Including the equalizing ring) should not exceed 20m; the device body should adopt a structure suitable for on-site rapid assembly and long-distance transportation.
- c) The equalizing ring should adopt a double-ring structure, and the designed surface field strength of the equalizing ring should not be greater than 13kV/cm under the rated voltage.
- d) The output of the main body should adopt blocking filter.